Radiographic Perioperative Evaluation of Pancreatic Transplant

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Patient Presentation

- 41 y.o. female with Type I diabetes mellitus for 24 years
  - Difficulty controlling glucose levels
  - Frequent and severe episodes of metabolic complications (i.e. DKA)
  - Peripheral neuropathy
  - Chronic renal failure (diabetic nephropathy) requiring dialysis
Treatment Options

• Optimize insulin control
  – Alter type of insulin regimen used
  – Insulin pump for improved insulin dose control

• Treat/prevent secondary complications
  – Nephropathy: Strict BP control (ACEI); dialysis
  – Retinopathy: Photocoagulation
  – Neuropathy: Pain management

• PANCREAS TRANSPLANT
Selection Criteria at BIDMC

• Anyone with uncontrolled or poorly controlled Type I diabetes and at least one of the following:
  – HbA1C persistently >7%
  – Proliferative retinopathy
  – Diabetic Nephropathy diagnosed by biopsy or proteinuria
  – Autonomic or peripheral neuropathy
  – Frequent and severe metabolic crises resulting in hospitalization
BIDMC Contraindications

• Age must be between 13 and 65
• BMI > 35
• Type 2 diabetes mellitus
• CV disease
  – Recent MI
  – Significant CAD
  – CHF
  – Severe peripheral vascular disease with ischemia of at least one limb
• Cancer diagnosis within 5 years
• Possible difficulty with compliance to rigorous post operative medication regime
How common is this procedure?

• The first clinical pancreas transplant was done with a simultaneous kidney transplant at the University of Minnesota on 12/16/66.
• Total of 14,000 pancreas worldwide
• Current annual average around 1000
Surgical Transplant Options

- Simultaneous Pancreas Kidney (SPK)
- Sequential Pancreas after Kidney (PAK)
- Living Donor Kidney Transplant Alone (LDKTA) + PAK
- Pancreas Transplantation Alone (PTA)
Transplant procedure: Exocrine Drainage Methods

- **Cutaneous graft duodenostomy**
  - Metabolic acidosis (loss of bicarbonate)
- **Open duct free intraperitoneal drainage**
  - Severe peritonitis & amylase ascites
- **Polymer duct injection and occlusion**
  - Severe pancreatitis
- **Enterovesical drainage**
  - Chronic cystitis, reflux pancreatitis, recurrent UTI, metabolic acidosis, urethritis
- **Enteric drainage: Side-to-side duodenoenterostomy currently preferred**
Side-to-side Duodenoenterostomy

- Donor Duodenal Stump
- Donor Pancreas
- Recipient jejunum or ileum

Enteric anastomosis

Vascular Anastamoses

- Arterial anastamosis: RLQ using donor splenic artery and SMA to recipient common iliac via Y-graft
- Venous anastamosis
  - Portal:
    • Donor portal vein to recipient superior mesenteric vein
    • Physiologic, but technically very challenging
  - Systemic:
    • Donor portal vein to recipient common iliac vein
    • Technically less challenging
    • Possible complications: Hyperinsulinemia resulting in dyslipidemia, accelerated atherosclerosis, and insulin resistance
  - Retrospective study indicating graft survival higher in portal (79%) vs systemic (65%) anastomosis

Causes for Graft Loss

- Technical Failure: 9%
  - Vascular thrombosis (Most common complication)
  - Anastomotic leak
  - Infection
  - Pancreatitis
  - Bleeding

- Allograft Rejection: 3-16% at 1 yr
HOW CAN WE IDENTIFY THESE PROBLEMS?

RADIOLOGY
Imaging technique: Ultrasound

• Advantages
  – Very good at assessing vasculature using spectral and color flow doppler
  – No radiation
  – Can identify peri-pancreatic fluid collections

• Limitations
  – Pancreas does not have discrete capsule resulting in difficulty visualizing pancreas among bowel loops
  – Etiology for fluid collections cannot be delineated
Patent Pancreatic Transplant Vessels by Color Flow Doppler

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Patent Pancreatic Transplant Vessels by Spectral and Color Flow Doppler

Good Arterial and Venous Wave Pattern

Images Courtesy of Dr. Tkacz and Dr. Kruskal
US Vascular Evaluation #1

Patient with lower abdominal pain and rising glucose levels

Proximal vessel entering pancreas

Lack of vascular flow in pancreas by color doppler

**Diagnosis:** Arterial Thrombosis

**Resulted in allograft pancreatectomy**

Images Courtesy of Dr. Tkacz and Dr. Kruskal
US Vascular Evaluation #2
Patient with rising glucose levels

Hypoechoic region = fluid

Heterogenic echoic region in pancreatic head

Pancreatic Duct

Hyperechoic region in pancreatic tail

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Spectral flow analysis showed decreased arterial flow to pancreatic head

**Diagnosis:** Pancreatic Head Thrombosis

**Resulted in pancreatic head resection**

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Imaging Technique: CT

**Advantages**
- Effective enteric anastomotic leak detection via oral contrast extravasation
- Detection and evaluation of fluid collections
  - Hematoma, ascites, pseudocysts, abscess, or urinoma
- Evaluate complications of pancreatitis
  - Abscess, pseudocyst, adjacent tissue involvement
- Vascular compromise evaluation can be done with contrast
- CT guided drainage of pseudocysts, abscess, fluid

**Disadvantages**
- Severe renal failure precludes IV contrast
- Often difficult to differentiate fluid collections and changes of pancreas morphology
- Largest radiation dose
Where is that pancreas?

Kidney Transplant

Pancreas Transplant

Sutures

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Common Findings Post-Transplant

Low attenuation pancreatic transplant
dDx: 1) Pancreatitis
     2) Vascular Occlusion
     3) Rejection

Peri-pancreatic fluid
dDx: 1) Edema
     2) Hematoma
     3) Ascites
     4) Pseudocyst
     5) Abscess
     6) Urinoma

Dx: Pancreatic Rejection with surrounding edema from inflammation
Abdominal Distension and ? Bowel Obstruction

Multiple Large Loculated Hypodense Regions with HU of Fluid

dDx: 1) Pseudocyst
     2) Lymphocele
     3) Seroma
     4) Abscess

Dx: Pseudocyst

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Fever and Abdominal Pain

Fluid collection with air

Stranding and fluid indicating inflammatory changes

dDx:
1) Abscess
2) Pseudocyst
3) Cyst

Images Courtesy of Dr. Tkacz and Dr. Kruskal
What can we do?

Drain the fluid with CT guidance!!

Fluid was purulent
Dx: Abscess

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Demonstration of Pancreas Hypoperfusion on Arterial Phase of CT

Non-enhanced pancreas transplant

Contrast in external and internal iliac arteries

Contrast enhanced kidney transplant

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Imaging technique: MRI

• Advantages
  – Excellent visualization of soft tissue structures
  – Effective alternative when difficult visualization by US or CT
  – Contrast enhanced MRA and MRI useful in assessment of vasculature
    • Useful in pts who had a poor US study and cannot have CT IV contrast (renal compromise)
    • Study by Boeve WJ et al. indicates efficacy of modality when compared to intra-arterial digital subtraction angiography
  – No radiation

• Disadvantages
  – Still undefined role in pancreatic transplant evaluation
  – Takes more time to image
  – Some patients are contraindicated for imaging
Persistent Abdominal Pain and Inconclusive CT study

VIBE Sequence

Cecum
1) Thick Walls
2) Hypointense periphery

Suggestive of pneumatosi

NOT ALL POST-SURGICAL COMPLICATIONS INVOLVE THE PANCREAS

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Persistent Abdominal Pain and Inconclusive CT study

Lack of Contrast = Portal vein thrombus

VIBE scan – Delayed post-gadolinium

Dx: Ascending Pyelophlebitis with Portal Vein Thrombosis

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Diagnosis of Rejection

• Histopathologic by CT-guided or US-guided biopsy

• Chemical markers
  – SKP - ↑ serum Cre (Kidney function serves as proxy)
  – PTA vesical drainage - ↓ urinary amylase
  – PTA enteric drainage - ? ↑ blood glucose levels
  – ↑ serum amylase/lipase non-specific

• Imaging???
  – US: Resistive Index not proven to be effective
  – CT: No role
  – MRI: Dynamic contrast enhanced MRI: Krebs TL et al.
Percutaneous Biopsy

• Can be done with CT or US guidance
• Must consult and plan with transplant team
• 20g biopsy gun at more than one site
  – Possible differences in histology
  – Usually sample mid and proximal pancreas
• Post-biopsy complication of mild to moderate pancreatitis common
CT-guided Biopsy

Images Courtesy of Dr. Tkacz and Dr. Kruskal
Comparison of Gadolinium-enhanced GRE MR

Viable Pancreas

Rejected Pancreas

Arrowheads: Kidneys  Arrows: Pancreas  Curved Arrows: Duodenal Stump

Dynamic Contrast-enhanced MRI Evaluation of Acute Rejection

- Mean percentage of parenchymal enhancement (MPPE) determined at 1 minute post-gadolinium load
- MPPE corresponded to histopathologic analysis
- Demonstrates decreased MPPE with rejection compared to viable transplant

Summary

• **Immediate Perioperative Evaluation of Symptomatic Patient**
  – US: Confirm vascular competency (r/o thrombus)
  – CT:
    • Complications of severe pancreatitis
    • Anastomotic leak
    • Fluid collections
  – MR: Evaluate inconclusive US and/or CT study

• **Rejection Evaluation**
  – CT or US guided biopsy
  – ? Utility of MR
References

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